The Potential Competitive Impacts of Basel II in the U.S. Market for Residential Mortgages

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by

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My name is James Follain. I am currently the SVP of Mortgage Valuation for Fidelity Hansen Quality. I have a Ph.D. in economics and have spent nearly 30 years as an economist specializing in the housing and mortgage markets. My comments this morning are based upon work done jointly with Dr. Paul Calem who is a VP for Loan Performance. Previously, Dr. Calem spent 20 years as an economist at the Federal Reserve Bank of Philadelphia and the Federal Reserve Board and studied many aspects of the banking industry. Paul and I appreciate the opportunity to share our views with you.

I. Introduction

In June of 2004, the Basel Committee on Banking Supervision published the outcome of its work over the past several years to produce significantly more risk-sensitive regulatory minimum capital requirements for internationally active banks.[1] The new agreement is an update of the 1988 Accord (Basel I) and is widely referred to as the Basel II Accord. The most advanced set of rules that define minimum capital requirements under Basel II, called the Advanced Internal Ratings Based (AIRB) approach, places substantial reliance upon banks' internal data and risk measurement and management processes.[2]

Now that the principles of Basel II have been agreed to internationally, regulators in each participating country are now focused more fully upon their respective implementation plans. In determining how broadly the new rules should be applied in the

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[1] See Basel Committee on Banking Supervision BIS (2004).

[2] Two alternative sets of rules – the Foundation approach and the Standardized approach – incorporate more risk sensitivity than Basel II but stop short of the variations in risk sensitivity of capital requirements associated with the AIRB approach

U.S., regulators face a tradeoff between the explicit costs of implementation across a broad spectrum of banking organizations and the benefits of widespread adoption of a more risk-sensitive system of regulatory capital requirements. In addition, regulators must factor into their calculations a potentially substantial, implicit cost of a narrower implementation plan -- the potential to alter the existing competitive landscape among U.S. banking organizations in the market for residential mortgages. This topic is the focus of our paper.

At one end of the range of implementation possibilities is a plan that requires full-implementation of the AIRB approach for all banking organizations. This would almost surely impose an unjustifiable burden for many smaller banking organizations and bank regulators. At the other end is a bifurcated plan in which only the largest internationally active banking organizations would be required to implement the AIRB approach (adopters). This would impose little or no explicit costs on nonadopters, but it has the potential to generate less explicit costs that may arise from the impact of a bifurcated implementation upon the competitive landscape between adopters and nonadopters. Of course, variants between these two limits are possible.

U.S. regulators have, in fact, proposed a system closer to the latter. The plan calls for ten or so of the largest banking organizations to be required to adopt the AIRB approach. Though a small number may choose to apply for AIRB status (opt-in candidates), all of the other 8,000 or so banking and thrift organizations would continue to operate under Basel I rules. Hence, limiting the implementation to only the largest organizations attains some of the intended benefits of Basel II – greater risk sensitivity of capital requirements for some large banking organizations – while avoiding the imposition of any substantial costs (explicit or implicit) upon nonadopters.

When this implementation plan was originally proposed, regulators expressed a belief that the competitive effects within the U.S. are unlikely to be significant due to changes in regulatory capital requirements.[3] A recent study by the Federal Reserve Board also concluded that the potential competitive effects for the case of residential mortgages will be small.[4]

Our best reading of the evidence available leads us to offer an alternative view regarding the quantitative impact of the proposed implementation plan in the market for residential mortgages. In brief, the cost of investing in such mortgages will be lower for adopters than nonadopters, which will permit them to offer lower interest rates to consumers and to gain market share at the expense of nonadopters. Nonadopters that specialize in holding residential mortgages will be especially impacted by the proposed plan.[5]

The economic rationale underlying our view is actually quite simple. Adopters will gain a cost advantage relative to nonadopters for some categories of mortgages with relatively low amounts of risk because Basel II will greatly reduce the regulatory capital requirements for these residential mortgages. Given what we believe to be a highly competitive market among banking organizations for residential mortgages, business will eventually shift to the low cost provides of these mortgages.

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[3] See, for example, Ferguson (2003).

[4] See Hancock, et al. (2005).

[5] Our attention is focused primarily upon competition among banking and savings organizations subject to Basel II. The current role of the two large government-sponsored enterprises (GSEs) – Fannie Mae and Freddie Mac – and the potential impacts of heightened competition for residential mortgages between them and the adopters are discussed, but they are not deemed central to the decision facing the regulators about Basel II unless bank regulators place a benefit on a reduced size of the GSEs as a benefit of Basel II. Frame and White (2004) and Hancock, et al (2005) discuss this aspect.

A difficult and challenging for all analysts of this issue is the precise measurement of the likely change in the distribution of mortgage investments between adopters and nonadopters. One reason stems from the lack of detailed information available to either the public or the regulators (e.g. Call Report data) on the $2.3 trillion holdings of 1-4 family residential mortgages by U.S. banking organizations. Another is the complexity of the residential mortgage market and, especially the complex ways in which it is affected by securitization. Here, we offer an analysis designed to articulate and validate as best we can a view that the proposed bifurcated regulatory capital system may have significant competitive effects in the case of residential mortgages.

Our presentation begins with some background information about the market for residential mortgages and Basel II's treatment of mortgages (Section II). The third section presents the assumptions underlying our calculations; our specific estimates of the amount of business that may be lost by nonadopters are presented in Section IV. The final section offers a brief summary and suggestions to minimize the impacts while ensuring gains to consumers and the broader goals of Basel II.

II. *Key Assumptions*

The arguments presented in this paper rest upon a number of assumptions and perspectives about the role of capital in the residential mortgage market, the computation of regulatory capital for AIRB adopters, and the relative importance of regulatory capital in bank investment decisions. We seek to explain some of the requisite background information in this section.

A. *Capital costs can be a substantial component of the cost of mortgage investing*

The annualized cost of holding a residential mortgage consists of three major components (see, for example, Posner 2002).[6] The most substantial component is the cost of debt financing of the mortgage. In the case of banks, this component is typically approximated by the cost of deposits. The second component is the cost of originating and servicing the mortgage; these are largely operating costs and the cost of requisite infrastructure. The third is the cost of the credit and interest rate risk associated with mortgage investments.

Both credit and interest rate risk stem from the options available to borrowers. Credit risk arises from the put option available to borrowers and interest rate risk (including both spread and prepayment risk) from the call option available to them.[7] Investors demand a premium for assuming these risks, which can be expressed as the sum of two components: expected costs and the cost of capital. In the case of credit risk, expected costs refer to expected or average credit losses due to default. In the case of interest rate risk, expected costs refer to the ongoing costs of hedging activities designed to meet minimum duration and convexity targets.

Our focus is upon the capital cost associated with credit and interest rate risks because it is only capital costs that are directly impacted by Basel II. We define capital costs (C) as the annualized cost of equity capital set aside to insure against unexpected or extreme losses; that is, $C = i_e (K_c + K_i)$, where i_e is the price of equity capital, K_c is the capital set aside to insure against unexpected credit losses and K_i is the amount set aside for unexpected losses due to interest rate risk. The amounts of capital that banks would allocate internally; that is, in the absence of regulatory intervention, to cover losses in an extreme or highly unlikely outcome are known as economic capital.[8] Economic capital need not coincide with the capital allocated to meet regulatory requirements. Within the present context, our focus is upon the relationship between the regulatory environment and the two capital terms, since we do not expect Basel II to have a substantive impact upon i_e.

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[6] Posner (2002) presents a comprehensive look at variations in the cost components of mortgage investments.

[7] An enormous literature exists to explain and measure these option-based approaches.

The amount of economic capital for each of these risks varies widely among loans. For example, there is general agreement that a portfolio of prime fixed rate mortgages is exposed to substantially greater risk than a portfolio of prime adjustable rate mortgages. Smaller loans and loans with higher loan-to-value ratios also tend to be associated with lower interest rate risk. Clearly, there is wide variation in economic capital for credit risk among mortgages that differ with the borrower's credit rating (FICO score) and the original loan-to-value ratio (LTV) of the loan. For example, Calem and Follain (2003) calculate that the economic capital needed for the credit risk of a "risky" loan (620 FICO, 95 percent LTV) is over 20 times that for a "safe" loan (740 FICO, 70 percent LTV). In addition, economic capital needed for credit risk is substantially higher for banking organizations with more geographically concentrated mortgage loan portfolios.[9]

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[8] In other words, economic capital is chosen to meet a certain risk tolerance or probability of bankruptcy.

[9] Economic capital for a portfolio with whole loans from a wide variety of regions – nationally diversified – is lower than is economic capital for a portfolio of similar risk characteristics from a single region – regionally concentrated.

To demonstrate the empirical significance of capital costs, consider the case of the standard mortgaged-backed security (MBS) issues by one of the two government-sponsored agencies (GSEs) in the secondary mortgage market, Fannie Mae or Freddie Mac. The GSE typically purchases loans from one or more originators and then packages them into an MBS. The originator receives the sale price of the loans and is largely out of the picture, although some may retain servicing or choose to purchase the MBS via a swap program. A portion of the cash flows from the mortgages goes to a servicing institution which is paid a servicing fee. The MBS is sold to an investor. The GSE retains the credit risk on the pool of mortgages (that is, it provides a credit guarantee, exclusive of the portion that is assigned to mortgage insurers, if applicable) and it receives a "guarantee fee" in return. The interest rate risk is transferred to the investor who purchases the MBS, who in turn receives coupon payments. In essence, this particular securitization process involves the sale of credit risk protection or a credit guarantee to the investors in the MBS in exchange for a guarantee fee.[10]

A simple example demonstrates the importance of capital costs to this particular investment type.[11] The gross guarantee fee charged by the GSEs for MBS backed by prime or high quality loans is currently in the range of 15-20 basis points. Assume that operating costs for this program are 5 bps, a cost of equity capital of 15 percent, and a ratio of tail loses to expected losses of four ($K_c/EL = 4$)**;** *then capital costs comprise 37.5 percent of total credit costs and 25 percent of total costs***.**[12]

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[10] Entities other than the GSEs -- including large banking organizations, the Federal Home Loan Bank system, and nonbanks -- also issue securities that transfer unbundled credit risk for pools of nonconforming mortgages. The Federal Home Loan Bank (FHLB) MPF program is an example discussed by Frame (2003), Frame and White (2004), and Van Order (2000). Under this program, a participating bank or thrift sells its loans to an FHLB and retains a second, or mezzanine, loss position. The FHLB holds a first loss and a catastrophic loss position. All of the interest rate risk is owned by the FHLB.

[11] The significance of these capital costs also depends upon the particular form of mortgage investment undertaken by an investor. Some may choose to invest in all aspects of the mortgages, but the practice of "unbundling" is the norm rather than the rule among mortgage investments. Unbundling refers to the ability of investors to focus their mortgage investments on one or more aspects of the income and risk associated with such mortgages. For example, some may focus upon the servicing income. Some may focus on the interest rate risk associated with mortgages and jettison both the risks and rewards associated with credit risk and servicing.

B. *Basel II will reduce regulatory capital requirements for mortgages*[13]

The existing Basel I capital requirements set two basic sets of information. The first is the total amount of capital required by the banking organization and the second is a set of risk-weights that vary among assets and are used to define total risk-weighted assets of the bank. Tier 1 capital is set at 4 percent of risk-weighted assets; total capital is set at 8 percent of risk-weighted assets. Risk-weights are stated relative to a 100 percent risk-weight. Residential mortgages ("prudently underwritten") have a 50 percent risk-weight and hence require 200 basis points of Tier 1 capital (200 = 0.50*400) and 400 basis points of total capital. Other assets have higher or lower risk-weights.

Separately, U.S. banks are subject to a set of "leverage" requirements (not part of the Basel Accord) that define required capital in terms of non-risk-adjusted assets. These vary by the rating a bank requires in order to achieve one of several categories of adequate capitalization. For example, a well-capitalized banking organization has at least total capital in excess of 10 percent and Tier 1 capital in excess of 5 percent. "Adequately capitalized" ratios are 8 and 4 percent, respectively. Although it is typical for Basel I capital requirements to exceed the leverage requirements for a bank involved in the full spectrum of credit risk, this is not always the case. Indeed, this situation is likely to be potentially important to mortgage lending specialists and it receives special attention below.

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[12] Define the guarantee fee as: $g = EL + G\&A + i_e K_c$. Assume $K_c = 4EL$, then $i_e K_c/g = .25$ if $G\&A = 5$ and $i_e = .0.15$.

[13] Pillar II pertains to additional capital requirements that can be imposed by bank regulators during the supervisory process. Pillar III refers to the use of public disclosure. More information can be found at: http://www.federalreserve.gov/generalinfo/basel2/default.htm.

As discussed by Calem and Follain (2003), the AIRB approach will generate substantial reductions in the minimum regulatory capital requirements for most residential mortgages. Examples of the Tier 1 minimum capital requirements are contained in Table II-1. The last row provides an estimate of the amount of Tier 1 capital that would be required for an adopter with an average portfolio of high quality mortgages that are well-diversified geographically. *The amount is 40 basis points, which is one fifth of the 200 bps that would be required by nonadopters, all else equal.* For some risk segments the difference is larger and for some others it is smaller.

C. *How regulatory capital rules can impact bank investment decisions*

We have now established how capital costs can influence the cost of mortgage investing and that Basel II will generate a substantial disparity in regulatory capital costs for typical mortgage investments between adopters and nonadopters. A remaining issue is whether banks' capital assignments and investment decisions for particular products are much or at all influenced by regulatory capital for those products. Alternatively stated, we wish to know whether regulatory capital rules are *binding*; that is, do they influence the investment decisions of banking organizations. If not, then a disparity in regulatory capital treatment would have no competitive impact. If so, then some competitive effects are possible via the process known as of regulatory arbitrage.[14]

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[14] Indeed, the process can be viewed as an example of the concept of the "regulatory dialectic", which was coined by Kane (1981) and is regularly cited in the banking literature as a concept to describe the "cat and mouse" game between banking organizations and their regulators. Recent examples with numerous references to his work are Kovakimian and Kane (2000) and Cabral dos Santos (1996).

Regulatory capital arbitrage is a shift in a particular line of banking business from the participant with a higher and binding regulatory capital requirement for this line of business to a participant with a lower capital requirement. In particular, a binding capital rule can lead to "the perverse result (is) that banks actually face incentives to hold riskier assets within each category" (See Emmons et. al, 2005).

The theoretical foundations of the concept of regulatory arbitrage are well established in the literature.[15] For example, Calem and Rob (1999) develop a model where a binding regulatory capital floor implies a shift in the composition of the loan portfolio toward riskier assets.[16] Van Order (2000) discusses the concept of regulatory capital arbitrage specifically in relation to mortgage portfolios and competition between banks and nonbanks. Frame and White (2004) discuss how Basel II bank regulatory capital may affect the competition between the GSEs and adopting banks. Below, we apply an analytical framework that is similar to but more specific than that of Frame and White and that highlights the potential transfers within the banking industry. The intuition behind all of these results is that profitability increases with leverage, with the amount of leverage determined by the inverse of the economic capital ratio.

Clearly, for Basel II to induce regulatory capital arbitrage in the form of mortgage investments shifting from non-adopters to adopters, it must be the case that current regulatory requirements are binding for banks at the aggregate institution level and on at least some categories of mortgage investments in particular. Empirically, the extent to which regulatory capital rules are binding and induce arbitrage is difficult to evaluate, but a sense that they have distorted bank risk-taking incentives was a significant factor motivating Basel II reforms. For instance, Jones (2000) argues that Basel I resulted in a shift in certain types of investments from banking organizations to nonbanking organizations not bound by Basel I rules. He cites securitization and, specifically, the emergence of the market for CDO securities (collateralized debt obligations) shifted certain business loans from banking organizations to a wider variety of investors.

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[15] There is a substantial theoretical literature on the relationship between capital regulation and bank risk taking. The literature generally suggests that banks will increase portfolio risk in response to a binding regulatory capital requirement. Under special conditions, this relationship need not hold; for instance, if relative risk weights under the regulatory standard align with relative economic capital as in Rochet (1992). See Allen (2004) for a review of this literature.

As already noted, for most residential mortgages, economic capital for credit risk is much less than currently required regulatory minimum capital. Therefore, one may reasonably conclude that total economic capital typically is less than regulatory capital in the case of mortgages characterized by relatively little interest rate risk, such as adjustable-rate loans or smaller loans. For further evidence, we offer a brief case study of the markets for credit risk and interest rate risk among conforming, conventional mortgages (loans eligible for purchase by the GSEs and not government-insured) as highly suggestive of an impact of binding regulatory capital rules on the distribution of these risks. The case demonstrates a close linkage between the market shares of the two GSEs and existing regulatory capital differences for the GSEs and banking organizations.

A widely accepted stylized fact is that the bulk of prime, fixed-rate conforming, conventional mortgages are held in the form of GSE MBS and with the attached GSE credit guaranty.[17] This GSE dominance in the market for credit risk of these mortgages is consistent with the hypothesis that regulatory capital can have substantial impacts. In particular, the GSEs enjoy a much lower regulatory minimum capital requirement than do banking organizations for the credit risk on this class of mortgages. GSE capital rules require 45 basis points of equity capital for bearing the credit risk associated with their outstanding MBS (whether the MBS are held in their own portfolios or held by others). The comparable concept for banks is the Basel I Tier 1 minimum capital requirement for banking organizations which is 200 basis points. Thus, the GSEs have a large regulatory capital advantage for credit risk and dominate this particular market.

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[17] Data to measure the size of the conventional, conforming market and the GSE are not available owing, especially to the difficulty of measuring loans that satisfy the evolving GSE underwriting criteria. Nonetheless, we are confident that most would agree with our estimate for what we have in mind -- conventional, prime fixed-rate mortgages, which have been the focus of GSE securitization for many years.

Clearly, the regulatory capital advantage is not the only possible source of GSE dominance in this area. Indeed, to be truly binding on a particular category of mortgage assets, the regulatory capital requirement must exceed the sum of economic capital for both interest rate and credit risk, and this will not necessarily be the case for all conforming mortgage categories. Moreover, other factors, such as economies of scale or historical advantages may contribute to the GSE dominance. Nonetheless, we find the regulatory capital considerations to be quite compelling.

In contrast, the GSEs are much less dominant in the market for the interest rate risk associated with conforming, conventional mortgages. This is measured by the distribution of the holdings of the GSE MBS, since these involve interest rate risk and no credit risk to the investor. The GSEs held about $950 billion of the $3 trillion (in outstanding GSE MBS at the end of 2003 (OFHEO, 2004), which is a 31 percent share. The rest were held by banks, thrifts, insurance companies, and other investors. Banks and thrifts held about $960 billion of MBS and collateralized-mortgage obligations backed by the GSEs and GNMA at the end of 2003.[18] So even allowing that some of the $960 billion in bank holdings of MBS are GNMA securities, the distribution of this particular form of investment is much more equally distributed than is the investment in the credit risk associated with conventional conforming market.

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[18] This information was obtained from the FDIC's web site: http://www2.fdic.gov/sdi/main.asp.

This stylized fact is also consistent with the differential regulatory capital charges levied on banks versus the GSEs. The implicit charge for bearing the interest rate risk on an MBS held in its portfolio is 205 basis points of regulatory capital, which is higher than the 80 basis points of Tier 1 capital required of banks.[19]

Also noteworthy is that banking organizations retain only about 20 percent of their originations with size below the conforming loan limits and about 50 percent of other mortgage originations (based on analysis of Home Mortgage Disclosure Act data). This fact is consistent with a regulatory arbitrage motivation for sale of conforming loans to the GSEs, and also suggests that there presently are fewer opportunities for regulatory arbitrage by banks in the nonconforming loan market.[20]

In sum, the stylized facts in the markets for the credit and interest rate risk on conventional, conforming mortgages are consistent with the notion that differences in regulatory capital rules can contribute to substantial differences in the distribution of these risks among potential investors. Alternatively stated, the differences in regulatory capital rules appear to be binding, leading to regulatory arbitrage and contributing to substantial differences in the investment decisions of the GSEs and banking organizations. We believe they are strongly suggestive about how Basel II and its bifurcated implementation may affect the competitive landscape for mortgages. Specifically, the lower regulatory capital rules available to adopting banks will provide them with an opportunity to dominate nonadopting banks in the market for credit risk protection on nonconforming mortgages in much the same way that the GSEs dominate banks in today's environment.

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[19] A GSE must also hold 250 basis points for a prime MBS held in a GSE portfolio. Since 45 basis points is associated with the credit risk guarantee associated with all of its MBS whether held in portfolio or not, the implicit minimum regulatory capital charge for bearing the interest rate risk of the MBS held in portfolio is 205 basis points (250 -45). In contrast, for a banking organization, 80 basis points of tier 1 capital (corresponding to a 20 percent risk weight) would be required for holding a GSE MBS (assuming other regulatory capital requirements, including the leverage requirement, are met). Thus, under Basel I, banking organizations face a *lower* marginal regulatory minimum capital charge for holding either an MBS (80 basis points per dollar of outstanding balance of the MBS) or a whole, prime loan (200 basis points) than the GSEs' regulatory capital charge for holding an MBS (250 basis points).

[20] One reason is that the costs associated with capital arbitrage transactions with GSEs are smaller than those associated with other nonbanks, due, for instance, to economies of scale, established channels or relationships between individual banks and the GSEs. Another reason is that both banks and the GSEs may have cost of debt or informational advantages relative to other nonbanks. A fundamental premise of our analysis is that regulatory capital arbitrage between adopters and nonadopters under Basel II will be less costly than is currently the case between banks and nonbanks other than the GSEs. Reasons why we expect this to be the case include the existence of established origination networks of adopters and of correspondence networks between nonadopters and adopters, and a relatively level playing field with respect to the cost of debt and information. We note disagreement between ourselves and Hancock, et al. (2005) on this premise.

III. Measuring the Potential Impact of a Bifurcated Approach

The purpose of this section is to specify more precisely how a bifurcated implementation of Basel II is, in our view, likely to impact the competitive landscape for mortgages among banking organizations. A change in the competitive landscape is possible because the regulatory capital requirements for residential mortgages will be significantly lower for those who adopt the AIRB capital rules (adopters) versus those who do not (nonadopters) The differences may set in motion a regulatory arbitrage process in which the adopters will increase their share of investments in residential mortgages relative to nonadopters.

We propose two cases (scenarios or channels) in which adopters may gain at the expense of nonadopters in the mortgage market by virtue of the bifurcated approach. Both are premised on the prediction that Basel II will reduce the cost to adopter banking organizations of bearing the credit risk of high-quality residential mortgages.

In the first case, *whole loan transfer (case 1)*, adopters would be able to acquire for their own portfolios a larger fraction of mortgage originations relative to nonadopters. Alternatively stated, case 1 predicts that adopters will end up holding more of both the interest rate and credit risk associated with residential mortgages relative to nonadopters. The second case, *transfer of only credit risk (case 2)*, posits that a significant share of investment in *only* the credit risk of mortgages would shift to adopting banking organizations from nonadopters. The unbundling of interest rate and credit risk implied in this case might be done in any number of ways that include GSE like securitization or simply the purchase of credit guarantees or protection by nonadopters from adopters. Although this case will likely involve some effect on competition between adopter banking organizations and the GSEs, our emphasis is upon competition among banking organizations for types of mortgages that currently are commonly held in bank portfolios. That is, we focus is on competition among banking organizations for adjustable rate mortgages and *nonconforming* mortgages.

A. *Case 1: whole loan transfer*

This case predicts that adopting banks will hold relatively more residential mortgage debt (more whole loans) than nonadopting banks under the bifurcated approach. That is, some whole loans will be transferred from nonadopters to adopters over some period of time.

Theoretical models of regulatory capital arbitrage offer a motivation for this prediction. Adopters can be viewed as banks in which the new regulatory capital rules would not be binding; that is, the AIRB rules reflect economic capital. Nonadopters, however, will continue to operate in an environment in which the regulatory rule is binding for at least some mortgages. Hence, regulatory capital arbitrage would lead to a shift in holdings of lower-risk mortgages to adopters from nonadopters, all else equal.

A more precise statement of case one requires a definition of the cost of financing an investment in a mortgage. The cost of financing per dollar of mortgage debt then can be written as:

$C = i_d (1-K) + i_e K + EL + GA;$

where C is the marginal cost of investing in a new residential mortgage; K again denotes the amount of capital for the mortgage, i_d is the cost of debt financing; i_e is the cost of equity financing; EL represents expected credit losses; and GA represents general administrative expenses. The mortgage coupon rate earned on the mortgage less this cost of financing represents the spread income earned by the bank. Higher amounts of capital reduce the riskiness of the investment to the bank and reduce the spread income earned on the investment.[21]

For a bank that is unconstrained by regulatory capital rules, which we assume would be the case for adopters under Basel II, $K = K_e$, the amount of economic capital for the mortgage. For non-adopters, the capital requirement (K_{na}) for a particular mortgage type will be the maximum of economic and regulatory capital; that is, $K_{na} = \max(K_e, K_r)$. So, for example, if the sum of economic capital for interest rate and credit risk for the mortgage is less than the regulatory requirement of 400 basis points, K_{na} equals 400 basis points.[22]

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[21] Other ways of reducing the risk of this investment such as options could be included as capital substitutes; we simply assume that the bank chooses the least costly way of hitting its risk tolerance targets with capital or capital substitutes.

[22] Similarly, the amount of Tier 1 capital required by nonadopters would be 200 bps in this case.

The advantage to the adopter versus the nonadopters is the difference in their cost of financing the same mortgage. Holding everything else the same except for the amount of capital held by adopters under Basel II produces the following expression of the difference in the cost of financing for the case in which the regulatory capital amount is binding:

$$\Delta C = C_{na} - C_a = \mathrm{Max}[0, (i_e - i_d)(K_{na} - K_e)] = \mathrm{Max}[0,(i_e - i_d)(K_r - K_c - K_i)] > 0.$$

The last term highlights an important point; that is, the size of the regulatory advantage depends upon the amount of both interest rate and credit risk in the mortgage.

The cost difference varies significantly among products because of variations in the economic capital for both interest rate and credit risk. Several examples are provided to illustrate this point (see Table III-1). The first three pertain to the same 30 year fixed-rate mortgage (FRM) but with three different assumptions regarding its interest rate risk. In all three cases, the duration of the mortgage is 3.5, which is consistent with the change in the value of this type of mortgage for a 200 bps increase in the level of interest rates.[23] The first of these three cases assumes the mortgage is financed with a liability with duration of 1 while the second is financed with liability duration equal to 3. The third of these examples simply assumes that interest rate risk capital equals 160 bps (total capital requirement), which is the amount of regulatory capital for a GSE issued MBS.[24] The other examples pertain to adjustable-rate mortgages with various types of indexes. For these, interest rate risk capital is set equal to the maximum of a duration based calculation or 160 bps. Other assumptions include: $i_e = 1250$ bps; $i_d = 250$ bps; $K_c = 100$ bps; regulatory capital = 400 bps; EL + GA = 20 bps.[25]

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[23] See OTS web site for these two tables: http://www.ots.treas.gov/pagehtml.cfm?catNumber=10

[24] We also point out that this amount of capital is below but near the regulatory capital required of the GSEs for their MBS investments (205 bps).

Two main conclusions emerge from these examples. First, adopters have an advantage under certain plausible assumptions in the cost of financing a mortgage investment relative to nonadopters. The advantage ranges from 0 to about 15 bps or 5 percent of the cost of financing to nonadopters under Basel I for the product categories and our assumptions underlying Table III-1. Second, these examples highlight the critical role of capital for interest rate risk in determining the size of the advantage to the adopters. In the first two examples, Basel I is not a binding constraint for nonadopters due to the large amount of economic capital allocated to interest rate risk; therefore, adopters have no advantage. The lower the amount of capital for interest rate risk, the larger the potential gain to adopters, all else equal.

B. *Case 2: credit risk transfer*

As noted in Section II, unbundling of credit risk from interest rate risk is commonplace in today's mortgage markets--the classic example is the GSE MBS, which allows banks to retain all of the interest rate risk on a pool of mortgages and transfer (for a price) all of the credit risk to the GSEs. Because the credit risk of residential mortgages can be unbundled, the holder of the mortgage may be viewed as having a derived demand for credit risk protection.

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[25] We do not include an explicit cost of transferring the mortgage. They are likely to be quite small at this point, although we do in the case our discussion of newly originated loans, Case 2. We could include such costs at this point as well even though they are not essential to Case 1. They are also likely to be quite small given the extensive network of mortgage brokers who may simply end up selling more loans to the adopters and bypassing nonadopters more frequently, and possibly even in the case of seasoned loans, given the existence of established correspondent networks between large and small banks.

The provider of credit risk protection must bear administrative expenses, expected losses, and the cost of holding a certain amount of capital (economic or regulatory) for this risk. The gross cost per unit of mortgage debt, *G* borne by the supplier of credit risk protection (which would be reflected in the guarantee fee that is charged) may be expressed as the sum of three cost components:

$G = EL + GA + i_e K.$

As with the cost of financing in case 1, the critical ingredient in our analysis of case 2 is the *marginal* amount of capital associated with such an investment (K_{na}). For the nonadopters, this depends upon the regulatory amount (K_r) and the amounts of economic capital for interest rate risk (K_i) and credit risk (K_c). Specifically, the amount of additional capital held by nonadopters for the *credit risk* of an additional mortgage is the maximum of two terms. The first of these terms is the additional amount of economic capital associated with the credit risk. The second term is additional amount of regulatory capital to the nonadopters, which is the difference between the Basel I regulatory rule for a mortgage and the amount of economic capital the bank would hold for interest rate risk. Thus, the marginal amount of capital to the nonadopters is: $K_{na} = \max (K_c, K_r - K_i)$.

If the Basel I rule is not binding for nonadopters $(K_c + K_i) > K_r$, then the adopters (whose additional capital for credit risk capital equals K_c) have no cost advantage due to Basel I. If it is binding, then the difference in costs can be written as:

$\Delta G = G_{na} – G_a = i_e (K_r - K_c - K_i) > 0$. Only the cost of equity matters in this calculation since the transfer is an off-balance sheet activity that involves no debt finance. Thus, comparison to the expression for ΔC, the cost differential in Case 1, reveals that $\Delta G > \Delta C$, which suggests that credit risk transfer would take precedence over whole loan transfer if Basel I is binding. However, at least for newly originated loans, unbundling may be more costly than whole loan transfer. Whereas the latter might simply occur through the actions of consumers or mortgage brokers choosing one originator over another or via established correspondent networks between banks, in the case of nonconforming loans (which comprise most of the loans traditionally retained in bank portfolios) unbundling may involve significant search and transactions costs among multiple parties (for example, originator, investment bank, rating agency, buyer of the security).[26] Thus, Case 2 would dominate Case 1 only if $\Delta G - C_{ub} > \Delta C$, where the term C_{ub} denotes the cost of unbundling.

As with Case 1, several examples are presented to provide a sense of the size of the advantage to the adopters for the same set of products and assumptions (see Table III-2). No advantage exists in the fixed-rate mortgage examples with substantial interest rate risk; in fact, the advantage is negative because we include a cost for the unbundling itself (we assume 2 basis points). Otherwise, the pattern is the same as in Case 1. The smaller the amount of capital for interest rate risk, the larger the advantage to the adopters. The percentage differences are, of course, much more pronounced than in Case 1 because the numerator is about the same size as in Case 1 but the typical guarantee fee is only 10 percent or so of the cost of financing the entire mortgage.

What kinds of mechanisms are available to bring about the transfers in Case 2? There are a number of possibilities. The simplest would involve an unsecuritized and straight forward credit guarantee in which the adopters would receive payments from the nonadopters in exchange for a guarantee of losses. Securitized options are possible as well. Something like the GSE credit guarantee is an obvious one. For example, one of the adopters would buy loans from nonadopters and issue an MBS with their credit guarantee. Many more elaborate securitization approaches are possible.[27]

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[26] IN contrast, economies of scale and direct channels from originators may allow the GSEs to accomplish unbundling at relatively low cost

Does the particular type of mechanism or process for the credit transfer affect the essence of our story? We think not. The degree to which a particular mechanism is preferred, as with the degree to which Case 1 would prevail over Case 2, would relate to the cost of unbundling.

Another possibility is that the optimal mechanism will be affected by another portion of the Basle II agreement we do not explicitly consider; these are the Basel II rules that pertain to capital requirements for securitization. Our reading of Basel II suggests this is a second order issue because of the guiding principle underlying the development of Basel II capital rules that affect securitization. In particular, the principle is to make banking organizations neutral with respect to either holding loans or holding securities based upon the loans.[28] To the extent this principle is achieved by the Basel II securitization rules, they will not affect our basic argument – adopters will have a cost advantage in case 2. The biggest impact of the securitization rules is likely to be their influence upon the broader choice between securitization and direct credit guarantees, although we agree that this issue is complex and worthy of more study.

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[27] The MODERNS security issued by Freddie Mac is one example; see Glenn (1999). A more general approach is labeled as a synthetic security and includes some done by Bank of America for the specific purpose of transferring credit risk on mortgages between two or more parties.

[28] See paragraph BIS(2004), paragraph 610, which states that: “For a bank using the IRB approach to securitisation, the maximum capital requirement for the securitisation exposures it holds is equal to the IRB capital requirement that would have been assessed against the underlying exposures had they not been securitised ….”

IV. The Aggregate Size of the Transfer

Now we address a more difficult but important question: is the potential aggregate impact likely to be materially significant? As noted above, it appears that the regulators originally may have underestimated the competitive costs of the proposed plan within the mortgage market. If so, then a finding of a sizeable or substantial potential aggregate impact in the market for mortgages may lead the regulators to revise the implementation plan to address these concerns.

It is not our aim to provide precise, quantitative predictions regarding the competitive impact of Basel I, in our view is rather impossible task. Rather we offer a rough or illustrative assessment of the likely impact, based on available information and what we consider to be plausible assumptions. Our strategy is to infer as best we can from the current composition of banking organization portfolios how the observed distribution of mortgage investments between adopters and nonadopters would differ if this distinction were already well established. In reality, of course, any such redistribution resulting from Basel II would involve a process of adjustment over time, and nonadopters could seek to regain lost income from mortgage investments through other activities. We abstract from these considerations.

The previous section provided some sense of the potential cost advantage to adopters under Basel II for various categories of mortgages classified by interest rate and credit risk. Our assessment of the potential aggregate impact requires two additional types of information. The first we refer to as the elasticity of the demand for the asset (ε) with respect to an advantage in either the cost of financing (Case 1) or the cost of a credit guarantee (Case 2). Specifically, 1 + ε is the percentage gain in market share that would result from a marginal percentage reduction in price; since a gain in market share is associated with a reduction in price, we associate with ε a negative sign. The second is the amount of investment (in whole loans or credit risk) by nonadopters is at stake in each risk segment; that is, how much could potentially shift to adopters? The first parameter allows us to quantify the potential impact for a segment of a given size within the mortgage portfolio of a nonadopters (step 1), while the latter allows us to aggregate among risk segments (step 2).

Step One: Size of transfer per risk segment. Consider first the case of a whole loan transfer (our case 1). The share of adopters after Basel II (S_a) in this case is defined as follows:

$S_a = IS_a + (1 + \varepsilon)\ \Delta C/C_{na}\ IS_{na}$

where IS_a is the initial share of this risk segment held by adopters; ΔC is the size of the cost advantage to adopters in this risk segment after Basel II; C_{na} is the cost of financing to nonadopters before Basel II is implemented (or under Basel I rules); and IS_{na} is the share of nonadopters before Basel II is implemented. In words, the new share for adopters is its initial share plus some fraction of the share held by nonadopters. The elasticity reflects the responsiveness of household demand for mortgage debt across various mortgage lenders to differences in the cost of debt.

We could find little direct evidence in the literature on this elasticity. However, anecdotes abound regarding the fragility of individual lenders' market shares and the highly competitive structure of the mortgage market, which leads us to posit an elasticity that is relatively large, in the range of -2 to -5.[29] Some affirmative insights were obtained from a recent study by Ambrose and Saunders (2003), who evaluate the probability that the originator of a mortgage will either hold or sell it. The estimated coefficients of their empirical model of the decision to hold or sell a loan can be used to infer the sensitivity of this choice to the lender's pricing advantage. We performed such calculations and concluded that the model suggests an elasticity of loan sale three or higher. Although this elasticity measure is not identical to the one we have in mind, the values calculated for it are consistent with a highly competitive market structure.

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[29] The elasticity we have in mind has to do with household demand among many suppliers at one point in time, as distinct from the elasticity of the aggregate household demand for mortgage debt that was studied

Simple examples to illustrate the impact of elasticity on the amount of investment that would shift from adopters to nonadopters within a particular risk segment are presented in Table IV-1. The calculated sizes of the transfer vary with assumptions regarding the initial market shares and the elasticities. The particular risk segment used in this example is the ARM with a market index of less than six months. Consistent with the calculations in Table III-I, the cost of financing to nonadopters is set at 310 basis points, and the cost advantage to adopters under Basel II at 14 basis points. In particular, we continue to assume that economic capital for credit risk is 100 basis points.

The largest impacts pertain to a case with a relatively small initial market share for adopters (30 percent) and a relatively high elasticity (-5). In this case, $332 million in annual net income associated with investing in this risk segment is transferred to adopters from nonadopters per $100 billion in this risk segment. Their market share increases from 30 to 42 percent of this risk segment, but they earn less per dollar of investment in this risk segment because they are assumed to price based upon their lower cost of

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by Follain and Dunsky (1998) and Dunsky and Follain (2000). The only reasons it would not be "infinitely elastic" would be due to issues such as customer loyalty, the cost of searching among lenders, potential cross-selling benefits, etc. A quote from one lender with whom we spoke captures the spirit of what we have in mind: "the heightened focus of customers on the price of credit has reduced the value of customer loyalty to about 25 basis points."

capital. Nonadopters lose more than the adopters gain. Their market share declines to 58 percent and the price they earn on this smaller share also declines. The net impact is a loss $472 million per $100 billion in this risk segment. Lowering the elasticity to -2 and the adopters' initial market share to 45 percent reduces these estimates to $10 million gained by adopters and $150 million lost by nonadopters per $100 billion investment in this risk segment.

We apply similar logic to assess the potential size of the transfer that would occur in Case 2—credit risk transfer—for a particular risk segment, although the analysis for this case involves three distinguishing features. The first difference is the definition of the base price. Here we use the guarantee fee (G) charged for credit protection as the basis of the share calculation; that is,

$S_a = IS_a + (1 + \varepsilon)\ \Delta G/G_{na}\ IS_{na}$;

otherwise, all other terms are the same as in Case 1. The second difference is that we limit the maximum potential market share of adopters to 80 percent, which is what many believe to be the share of the GSEs in the market for credit risk protection for conforming mortgages.[30]

As with Case 1, we generate some examples to illustrate the potential impacts for particular risk segments.[31] One specific risk segment evaluated includes fixed-rate 30 year mortgages with the capital for interest rate risk set to 160 bps. As in Case 1, the largest impacts pertain to the case with a relatively small initial market share for adopters (30 percent) and a relatively high elasticity (-5). In this case, adopters earn an additional

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[30] Implicitly, we are assuming in this example and throughout our analysis that the elasticity of market share approaches zero as the adopters' share approaches 80 percent; whatever dominance the adopters may gain will not exceed that currently enjoyed by the GSEs.

[31] Tables with our calculations are available upon request of the authors.

$126 million in annual net income associated with the provision of credit risk protection for this risk segment per $100 billion in this risk segment. Their market share increases from 30 to 80 percent of this risk segment; the 80 percent is the maximum we impose. Nonadopters lose $281 million per $100 billion in this risk segment. Lowering the elasticity and the initial market share assumptions produces a loss to both adopters and nonadopters. Adopters lose -$11 million per $100 billion of debt in this risk segment because the gain in market share is offset by a much lower price per dollar of credit protection offered.[32] Nonadopters lose $144 million per $100 billion investment in this risk segment.

Step 2: Aggregating among risk segments. The ideal set of information needed to classify residential mortgage debt held by banking organizations for our purposes -- the distribution of the debt across risk segments classified by degrees of interest rate and credit risk--is simply not available to regulators or to the public. Hence, we pursue a less ambitious approach and focus upon what we believe is the more critical variable – the distribution of mortgage debt across segments defined by amount of interest rate risk. Risk segments for this analysis are distinguished by the repricing dates or remaining maturities of closed, first lien mortgages on 1-4 mortgage loans. We use information on the distribution of mortgage holdings across such risk segments from first quarter 2004 Call Report data for commercial banks. We then average the aggregate impacts that are calculated for the various initial market share and elasticity assumptions used in Table IV-I. These results are summarized in Table IV-2.[33]

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[32] The ex ante ROE remains 15 percent for the entire amount of the investment by nonadopters because we used this assumption in the calculation of the credit guarantee fee.

[33] A detailed explanation of the assumptions embedded in our estimates is available in the previous version of this paper and in a separate appendix available from the authors.

Consider, first, the aggregate gains to adopters under Case 1 and Case 2, which we estimate to be about $279 million and $116 million, respectively. We view these two estimates as offering a range of what may be gained by adopters not as separate components that should be added. Case 1 is more beneficial to adopters because they end of capturing the both the interest risk and credit risk income. If only Case 2 comes about, the number and amount of mortgage debt affected by Basel II would be the same as in Case 1. However, the amount of income transferred under Case 2 would be less because only the credit portion would be transferred. The more likely outcome is that some income will be transferred via Case 1 and some via Case 2.

The most important results from a policy perspective pertain to the potential losses to nonadopters. Recall that their losses stem from two forces: their shares of the market declines and the income earned per dollar of debt owned declines. Nonadopters are projected to lose $880 million per year under Case 1 and $655 under Case 2. These losses would not be uniformly distributed among all nonadopters. Mortgage specialists among nonadopters would be most impacted by the proposed rule, in part because the marginal amount of regulatory capital will likely be the leverage ratio and not even the Basel I capital rule.[34] The subset of these with relatively large amounts of ARMs would be among those likely to be most at risk from heightened competition from the adopters.

These results are sensitive to our assumptions. One particularly important one is the amount of first-lien, 1-4 family mortgage debt. We use the amount owned by commercial banks; including the roughly $500 billion of such debt owned by thrifts increases the impacts by 50 percent so that the estimated losses to nonadopters straddle $1 billion in lost income per year. As such, the calculations presented in Table IV-2 may be somewhat conservative. Moreover, these calculations do not consider the potential impact on high credit quality second mortgages.

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[34] Using the definition offered by the FDIC – lenders with at least fifty percent of their assets in the form of residential mortgages and mortgage-backed securities –243 commercial banks (among 7,600) fit this description and these banks earn about $1.4 billion per year. We do not attempt to offer a precise estimate of their share of the losses, but it seems clear to us that the impact upon them would be substantial.

V. Key Conclusions and Policy Suggestions

We argue that the proposed bifurcated implementation plan for Basel II in the U.S. is likely to have a significant impact on the competitive landscape within the banking industry in its competition for residential mortgage investments. The impetus is the sizeable decline in the Basel II capital requirements for residential mortgages that will be available to adopting banking organizations relative to the requirements (existing Basel I rules) that will continue to apply to nonadopting banking organizations. The decline for adopters will trigger a regulatory arbitrage process in which nonadopting banking organizations may experience a non-negligible reduction in net income due to a reduction in their share of the market and the reduced price they earn in such investments. Although nonadopters can seek to regain this income through other activities, the alternatives most readily available to them are likely to be relatively risky.

Although we readily acknowledge the difficulty of producing precise estimates of this impact with information available to the public and regulators, we believe the evidence is more supportive of this position than the view that there will be little or no effect. We also readily acknowledge that policy-makers may view the costs of such a distortion in the competitive landscape outweighed by other advantages to Basel II and the lower mortgage rates that will likely be available to borrowers.

Potential and partial remedies to the problems we envision are possible. In particular, the capital rules pertaining to residential mortgages for nonadopters can be adjusted downward for the credit risk embedded in them. Something like the risk-weights associated with the Standardized approach (35 percent versus the current 50 percent) would move a long way toward reducing the potential for competitive inequities. These reduced weights would be assigned to banking and savings organizations with geographically dispersed investment portfolio and interest rate risk management processes designed to keep such risk to levels acceptable to regulators.

As noted above, mortgage specialists would seem to be among those especially at risk of competition from adopters under the proposed implementation plan. Although some may be obvious candidates for a reduction in the risk-weight for residential mortgages, such a reduction may be of little benefit to some mortgage specialists with large concentrations of prime ARMs. This latter subset of mortgage specialists are likely be bound by the more stringent leverage requirements. Otherwise, these mortgage specialists become candidates for expansion into riskier asset categories or candidates for acquisition by more diversified institutions. A more radical approach suggested by some is to introduce an alternative and lower set of leverage requirements. For example, mortgage specialists with a high quality and geographically diversified portfolios would be subject to, say, a 3 percent Tier 1 leverage requirement in order to be considered adequately capitalized.[35]

We conclude with a brief discussion of another potential and related impact of the bifurcated approach. It stems from the omission in the Pillar I minimum capital requirements for mortgages under both Basel I and Basel II of a particularly critical component of the cost of investing in mortgages – capital for interest rate risk. This omission, in our view, has the potential to generate undesirable competitive responses by nonadopters to their competitive disadvantage with respect to capital for credit risk—that is, shifting their portfolio to higher risk assets, and especially, increasing their exposure to interest rate risk. As a result, regulators may want to commit to increase their monitoring of the interest rate risk of nonadopting organizations with substantial mortgage investments.

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[35] See, for example, the comments of William Longbrake on behalf of Washington Mutual at: http://www.federalreserve.gov/SECRS/2003/November/20031106/R-1154/R-1154_67_1.pdf

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Table II-1: Proposed Basel II Capital for 1-4 Family Residential Mortgages

Selected examples of simulated PD, LGD, and Basel II capital by risk segments
(*Default defined as first occurrence of 180-day delinquency)*

LTV / FICO Score	**Annualized 10-year Default Rate (PD) (percent) (1)**	**Loss Generated by Default (Recession LGD) (percent) (2)**	**Risk Weight (percent) (3)**	**Marginal Tier 1 Capital Requirement (Basis points) (4)**
70 / 620	0.27	16	9	34
70 / 660	0.16	16	6	23
70 / 700	0.10	16	4	16
70 / 740	0.07	16	3	12
80 / 620	0.51	20	17	67
80 / 660	0.31	20	12	48
80 / 700	0.20	20	9	35
80 / 740	0.15	21	7	29
90 / 620	1.00	25	34	136
90 / 660	0.62	26	25	100
90 / 700	0.42	26	19	76
90 / 740	0.30	26	15	61
95 / 620	1.38	26	45	181
95 / 660	0.87	27	34	135
95 / 700	0.58	28	26	104
95 / 740	0.43	28	21	84
Jumbo Prime Pool	0.27	25	13	53
Alt-A Pool	0.28	35	19	77
Seasoned & Diversified Portfolio of Prime Loans	0.19	25	10	40

Source: Calem and Follain (2003).

Table III-1: Examples to Demonstrate the Cost Advantage to Adopters

	Duration of Asset	Duration of Liabilities	Capital for IRR for Typical Financing Kirr	Capital for Credit Risk (bps) Kcr	Total Econ K to Adopter	Total Capital for NonAdopter	Capital Advantage to Adopter	Cost of Financing to Adopter (bps)	Cost of Financing Advantage of Adopter (bps)
30 FRM Loans	3.5	1	500	100	600	600	0	330	0
30 FRM Loans	3.5	2	300	100	400	400	0	310	0
30 FRM Loans	3.5	NA	160	100	260	400	140	296	14
Market Index< 6 months	0.29		160	100	260	400	140	296	14

Table III-2: Examples of the Advantage to Adopters in Case 2 (Credit Risk Transfer)

	Effective Duration	Duration of Liabilities	Econ K for additional CR for Adopters	Reduced K due to CR Layoff for Nonadopters	Capital Advantage to Adopter	Cost of Credit Guarantee to Adopter (bps)	Cost of Credit Guarantee to NonAdopter	Cost of Credit Guarantee Advantage of Adopter (bps)	Cost of Credit Guarantee Advantage to Adopter (percent)
30 FRM Loans	5.6	1	100	100	0	35	33	-2.00	-6.2%
30 FRM Loans	3.5	2	100	100	0	35	33	-2.00	-6.2%
30 FRM Loans	3.5	NA	100	240	140	35	50	15.50	31.0%
Market Index< 6 months	0.29		100	240	140	35	50	15.50	31.0%

Table IV-1: Calculating size of income transfer via Case 1 for ARM with index adjustment less than six months

	Initial Share for Adopters	Cost of Financing Advantage to Adopters (bps)	Original Cost of Financing to Nonadopters (bps)	dCF/CF	Elasticity	New Share for Adopters	Additional Income for Adopters (bps)	Income Loss to Nonadopters (bps)	Net Income Gains to Adopters per $100 billion of UPB	Net Income Loss to Nonadopters per $100 billion of UPB
					ε	(1+ ε)dc/c + S)				
	30%	14	310	-4.5%	-5	42.6%	33	(47)	$ 332,296,774	$ (472,296,774)
	30%	14	310	-4.5%	-4	39.5%	24	(38)	$ 238,722,581	$ (378,722,581)
	30%	14	310	-4.5%	-3	36.3%	15	(29)	$ 145,148,387	$ (285,148,387)
	30%	14	310	-4.5%	-2	33.2%	5	(19)	$ 51,574,194	$ (191,574,194)
	45%	14	310	-4.5%	-5	54.9%	23	(37)	$ 231,090,323	$ (371,090,323)
	45%	14	310	-4.5%	-4	52.5%	16	(30)	$ 157,567,742	$ (297,567,742)
	45%	14	310	-4.5%	-3	50.0%	8	(22)	$ 84,045,161	$ (224,045,161)
	45%	14	310	-4.5%	-2	47.5%	1	(15)	$ 10,522,581	$ (150,522,581)
Average	37.5%	14	310	-4.5%	(3.50)	44.6%	15.6	(29.6)	**$ 156,370,968**	**$ (296,370,968)**

Table IV-2: Aggregate Impacts of Case 1 and Case 2

Time to Repricing	**Amount Held by Adopters**	**Shift to Adopters in Case 1**	**Shift to Adopters in Case 2**	**Loss to Nonadopters in Case 1**	**Loss to Nonadopters in Case 2**
Lt 3 months	13%	$ 81,672,171	$ 34,116,638	$ (257,989,710)	$ (191,787,927)
3-12 months	7%	$ 42,609,884	$ 17,799,282	$ (134,598,007)	$ (100,059,312)
1- 3 years	11%	$ 68,958,873	$ 28,805,956	$ (217,830,375)	$ (161,933,730)
3- 5 years	16%	$ 20,272,519	$ 8,468,371	$ (64,037,741)	$ (47,605,254)
5-15 years	24%	$ 29,418,656	$ 12,288,955	$ (92,928,966)	$ (69,082,809)
GT 15 years	29%	$ 35,910,481	$ 15,000,763	$ (113,435,633)	$ (84,327,336)
Total	100%	**$ 278,842,583**	**$ 116,479,964**	**$ (880,820,434)**	**$ (654,796,368)**